

WHAT IS CLAIMED IS:

1. A system for generating hydrogen comprising:

feed water;

a liquid metal nuclear reactor having a non-radioactive secondary heat loop;

5 a steam generator connected to said secondary heat loop, said steam generator capable of raising the temperature of said feed water;

a high temperature water cracking system, said feed water coupled to said water cracking system by a feed water input line; and

10 a topping heater, said topping heater capable of raising the temperature of said feed water.

2. A system in accordance with Claim 1 wherein said feed water comprises output from at least one of a desalination plant, a water clean-up system, and a steam turbine condenser.

15 3. A system in accordance with Claim 1 wherein said water feed input line is coupled to said steam generator, said steam generator raises the temperature of said feed water to between about 450°C to about 550°C.

4. A system in accordance with Claim 3 wherein said feed water is coupled to said topping heater downstream from said steam generator, said topping heater raises the temperature of said feed water to at least 850°C

20 5. A system in accordance with Claim 1 wherein said topping heater comprises a gas fired heater.

6. A system in accordance with Claim 5 wherein a portion of oxygen and hydrogen produced by said high temperature water cracking system is used as fuel in said topping heater.

7. A system in accordance with Claim 5 further comprising a first regenerative heat exchanger, and an exhaust from said gas fired topping heater is directed into said first regenerative heat exchanger, said feed water input line coupled to said first regenerative heat exchanger downstream of said steam generator.

5 8. A system in accordance with Claim 7 wherein said exhaust from said gas fired topping heater is directed to a desalination plant after passing through said first regenerative heat exchanger.

10 9. A system in accordance with Claim 7 further comprising a second regenerative heat exchanger, said exhaust from said gas fired topping heater is directed to said second regenerative heat exchanger after passing through said first regenerative heat exchanger.

15 10. A system in accordance with Claim 9 further comprising a steam turbine and generator assembly, and a portion of an output of said steam generator is directed through said second regenerative heat exchanger and to said steam turbine and generator assembly.

11. A system in accordance with Claim 1 further comprising a steam turbine and generator assembly, a portion of an output of said steam generator is used to drive said steam turbine and generator assembly to generate electricity.

20 12. A system in accordance with Claim 11 wherein said topping heater comprises an electric heater, and a portion of said electricity generated by said steam turbine and generator assembly is used to power said electric topping heater.

25 13. A system in accordance with Claim 1 further comprising an electricity producing fuel cell facility, and said topping heater comprises an electric heater, a portion of hydrogen and oxygen produced by said high temperature water cracking system is used as fuel in said electricity producing fuel cell, a portion of electricity produced by said fuel cell facility is used to power said electric topping heater, and water produced by said fuel cell facility is used as an addition to said feed water for said high temperature water cracking system.

14. A method for generating hydrogen utilizing a liquid metal nuclear reactor, the reactor including a non-radioactive secondary heat loop, said method comprising the steps of:

utilizing the secondary heat loop as a heat source for a steam generator
5 by coupling the secondary loop to the steam generator;

heating feed water in the steam generator;

directing the heated feed water from the steam generator to a topping heater;

heating the feed water utilizing the topping heater;

directing the heated feed water from the topping heater to a high temperature water cracking system to produce hydrogen and oxygen.

15. A method in accordance with Claim 14 wherein heating feed water in the steam generator comprises the step of heating feed water in the steam generator to a temperature of between about 450°C to about 550°C.

16. A method in accordance with Claim 14 wherein heating feed water in the topping heater comprises the step of heating feed water in the topping heater to at least 850°C.

17. A method in accordance with Claim 14 wherein the topping heater comprises a gas fired heater and said method further comprises the step of directing a portion of oxygen and hydrogen produced by the high temperature water cracking system to the topping heater to be used as fuel in the topping heater.

20

18. A method in accordance with Claim 17 further comprising the step of directing an exhaust from the gas fired topping heater to a first regenerative heat exchanger;

and directing the heated feed water from the steam generator to a topping heater comprises the steps of:

directing the heated feed water from the steam generator to the first regenerative heat exchanger;

5 heating the feed water in the first regenerative heat exchanger; and

 directing the heated feed water to the topping heater.

19. A method in accordance with Claim 18 further comprising the step of directing the exhaust from the gas fired topping heater to a second regenerative heat exchanger after passing through the first regenerative heat exchanger.

20. A method in accordance with Claim 19 further comprising the steps of:

 directing a portion of the heated feed water from the steam generator to the second regenerative heat exchanger;

 heating the feed water in the second regenerative heat exchanger;

15 directing the heated feed water from the second regenerative heat exchanger to a steam turbine and generator assembly; and

 producing electricity by utilizing the heated feed water to drive the steam turbine and generator assembly.

21. A method in accordance with Claim 14 further comprising the steps of:

 directing a portion of the heated feed water from the steam generator to a steam turbine and generator assembly;

 producing electricity by utilizing the heated feed water to drive the steam turbine and generator assembly.

22. A method in accordance with Claim 21 wherein said topping heater comprises an electric heater, and said method further comprises the step of directing a portion of the electricity generated by the steam turbine and generator assembly to the electric topping heater to power the electric topping heater.

5 23. A method in accordance with Claim 14 wherein the topping heater is an electric heater and said method further comprises the steps of:

directing a portion of the hydrogen and oxygen produced by the high temperature water cracking system to an electricity producing fuel cell facility;

10 producing electricity by utilizing the oxygen and hydrogen as fuel for the fuel cell facility; and

directing a portion of the electricity produced by the fuel cell facility to the electric topping heater to power the electric topping heater.

24. A method in accordance with Claim 23 further comprising the step of adding water produced by fuel cell facility as a byproduct to the feed water.